



CBSE Class 11 Physics Formula Sheet

110 formulas across 14 chapters — 2025-26 CBSE board exams

Ch 1. Units and Measurements

Dimensional formula of velocity

$$[v] = [M^0 L T^{-1}]$$

Dimensional formula of force

$$[F] = [M L T^{-2}]$$

Dimensional formula of energy

$$[E] = [M L^2 T^{-2}]$$

Dimensional formula of pressure

$$[P] = [M L^{-1} T^{-2}]$$

Significant figures: addition/subtraction

Result has fewest decimal places of any operand

Tip: For multiplication/division, result has fewest significant figures

Absolute error

$$\Delta a = |a_{\text{mean}} - a_i|$$

Relative error

$$\text{Relative error} = \Delta a / a_{\text{mean}}$$

Percentage error

$$\% \text{ error} = (\Delta a / a_{\text{mean}}) \times 100$$

Ch 2. Motion in a Straight Line

First equation of motion

$$v = u + at$$

u = initial velocity, v = final velocity, a = acceleration, t = time

Second equation of motion

$$s = ut + \frac{1}{2}at^2$$

s = displacement

Tip: Use this when time is given and displacement is asked

Third equation of motion

$$v^2 = u^2 + 2as$$

Tip: Use this when time is not given

Average velocity

$$v_{\text{avg}} = (u + v)/2 \quad (\text{only for uniform acceleration})$$

Displacement in nth second

$$S_n = u + a(2n - 1)/2$$

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Relative velocity

$$v_{AB} = v_A - v_B$$

Tip: If moving in same direction: subtract; opposite direction: add

Free fall acceleration

$$a = g = 9.8 \text{ m/s}^2 \text{ (downward)}$$

Tip: Take downward as positive; then $u = 0$ for a body dropped from rest

Ch 3. Motion in a Plane

Projectile: Range

$$R = u^2 \sin 2\theta / g$$

u = initial speed, θ = angle of projection, $g = 9.8 \text{ m/s}^2$

Tip: Maximum range occurs at $\theta = 45^\circ$

Projectile: Maximum height

$$H_{\text{max}} = u^2 \sin^2 \theta / 2g$$

Projectile: Time of flight

$$T = 2u \sin \theta / g$$

Projectile: Horizontal velocity

$$v_x = u \cos \theta \text{ (constant throughout)}$$

Projectile: Vertical velocity

$$v_y = u \sin \theta - gt$$

Centripetal acceleration

$$a_c = v^2 / r = \omega^2 r$$

v = speed, r = radius, ω = angular velocity

Centripetal force

$$F = mv^2 / r = m\omega^2 r$$

Relation: linear and angular velocity

$$v = \omega r$$

Ch 4. Laws of Motion

Newton's Second Law (N)

$$F = ma$$

F = net force (N), m = mass (kg), a = acceleration (m/s^2)

Impulse (N·s or kg·m/s)

$$J = F\Delta t = \Delta p = m(v - u)$$

Static friction (max)

$$f_s = \mu_s N$$

μ_s = coefficient of static friction, N = normal force

Tip: Static friction $\leq \mu_s N$; it equals applied force until this limit

Kinetic friction

$$f_k = \mu_k N$$

μ_k = coefficient of kinetic friction

Tip: $\mu_k < \mu_s$ always — kinetic friction is less than maximum static friction

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Pseudo force (non-inertial frame)

$$F_{\text{pseudo}} = -ma_{\text{frame}}$$

a_{frame} = acceleration of non-inertial frame

Tip: Directed opposite to the frame's acceleration

Normal force on inclined plane

$$N = mg \cos\theta$$

Acceleration on frictionless incline

$$a = g \sin\theta$$

Ch 5. Work, Energy and Power

Work done by constant force (J)

$$W = Fs \cos\theta$$

F = force, s = displacement, θ = angle between F and s

Tip: $W = 0$ if $F \perp s$ (e.g. centripetal force does no work)

Kinetic energy (J)

$$KE = \frac{1}{2}mv^2$$

Gravitational potential energy (J)

$$PE = mgh$$

Work-energy theorem

$$W_{\text{net}} = \Delta KE = KE_{\text{final}} - KE_{\text{initial}}$$

Conservation of mechanical energy

$$KE + PE = \text{constant} \quad (\text{no friction})$$

Power (W (Watt))

$$P = W/t = Fv \cos\theta$$

Spring potential energy

$$PE = \frac{1}{2}kx^2$$

k = spring constant, x = compression/extension

Elastic collision: kinetic energy

$$KE \text{ conserved} \quad | \quad v_1' = (m_1 - m_2)u_1 / (m_1 + m_2) \quad | \quad v_2' = 2m_1u_1 / (m_1 + m_2)$$

Ch 6. System of Particles and Rotational Motion

Torque (N·m)

$$\tau = r \times F = rF \sin\theta$$

Angular momentum (kg·m²/s)

$$L = I\omega = mvr \sin\theta$$

Newton's second law (rotation)

$$\tau = I\alpha$$

I = moment of inertia, α = angular acceleration

Tip: Rotational analogue of $F = ma$

Moment of inertia: thin rod (centre)

$$I = ML^2/12$$

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Moment of inertia: thin rod (end)

$$I = ML^2/3$$

Moment of inertia: disc (centre)

$$I = MR^2/2$$

Moment of inertia: ring (centre)

$$I = MR^2$$

Moment of inertia: solid sphere

$$I = 2MR^2/5$$

Parallel axis theorem

$$I = I_{cm} + Md^2$$

d = distance from CM to new axis

Rolling body KE

$$KE_{total} = \frac{1}{2}mv^2 + \frac{1}{2}I\omega^2 = \frac{1}{2}mv^2(1 + I/mR^2)$$

Tip: For a sphere: $KE = 7/10 mv^2$; for a cylinder: $KE = 3/4 mv^2$

Conservation of angular momentum

$$L = I\omega = \text{constant} \quad (\text{when } \tau_{net} = 0)$$

Ch 7. Gravitation

Newton's law of gravitation (N)

$$F = Gm_1m_2/r^2$$

$$G = 6.674 \times 10^{-11} \text{ N}\cdot\text{m}^2/\text{kg}^2$$

Acceleration due to gravity at surface

$$g = GM/R^2$$

M = mass of Earth, R = radius of Earth

Variation of g with height h

$$g_h = g(1 - 2h/R) \quad \text{for } h \ll R$$

Variation of g with depth d

$$g_d = g(1 - d/R)$$

Orbital velocity

$$v_o = \sqrt{GM/r}$$

r = orbital radius

Tip: At surface $r = R$, so $v_o = \sqrt{gR}$

Escape velocity

$$v_e = \sqrt{2GM/R} = \sqrt{2gR}$$

Tip: Escape velocity = $\sqrt{2}$ × orbital velocity at surface

Kepler's third law

$$T^2 \propto r^3 \quad \text{or} \quad T^2 = (4\pi^2/GM) r^3$$

Tip: More massive central body → faster orbital period

Gravitational potential energy

$$U = -GMm/r$$

Tip: Negative value: bound system; approaches 0 as $r \rightarrow \infty$

Ch 8. Mechanical Properties of Solids

Stress (N/m² or Pa)

$$\text{Stress} = F/A$$

F = applied force, A = cross-sectional area

Strain

$$\text{Strain} = \Delta L/L \text{ (longitudinal) or } \Delta x/L \text{ (shear)}$$

Tip: Strain is dimensionless

Young's modulus (Pa)

$$Y = (F/A) / (\Delta L/L) = \text{Stress} / \text{Longitudinal strain}$$

Bulk modulus (Pa)

$$B = -\Delta P / (\Delta V/V)$$

Tip: Negative sign: pressure increase → volume decrease

Modulus of rigidity

$$\eta = \text{Shear stress} / \text{Shear strain}$$

Hooke's Law

$$\text{Stress} \propto \text{Strain} \text{ (within elastic limit)}$$

Elastic potential energy per unit volume

$$u = \frac{1}{2} \times \text{stress} \times \text{strain} = \frac{1}{2} Y (\text{strain})^2$$

Ch 9. Mechanical Properties of Fluids

Pressure at depth h (Pa)

$$P = P_0 + \rho gh$$

P₀ = atmospheric pressure, ρ = fluid density

Pascal's law

Pressure applied to enclosed fluid is transmitted equally in all directions

Bernoulli's equation

$$P + \frac{1}{2}\rho v^2 + \rho gh = \text{constant}$$

Tip: Energy conservation for ideal fluid flow — fast flow → low pressure

Continuity equation

$$A_1 v_1 = A_2 v_2$$

Tip: Narrower pipe → faster flow

Stokes' law (viscous drag)

$$F = 6\pi\eta rv$$

η = coefficient of viscosity, r = radius of sphere, v = velocity

Terminal velocity

$$v_t = \frac{2r^2(\rho - \sigma)g}{9\eta}$$

σ = density of fluid

Surface tension (N/m)

$$T = F/L$$

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Excess pressure inside bubble (soap)

$$\Delta P = 4T/r$$

Tip: Soap bubble has two surfaces; liquid drop has one surface so $\Delta P = 2T/r$

Ch 10. Thermal Properties of Matter

Linear thermal expansion

$$\Delta L = \alpha L \Delta T$$

α = coefficient of linear expansion, L = original length, ΔT = temperature change

Volumetric thermal expansion

$$\Delta V = \gamma V \Delta T$$

$\gamma = 3\alpha$ for isotropic solids

Heat absorbed / released (J)

$$Q = mc\Delta T$$

m = mass, c = specific heat capacity, ΔT = temperature change

Latent heat (J)

$$Q = mL$$

L = specific latent heat

Tip: Temperature stays constant during phase change

Stefan-Boltzmann law (W)

$$P = \epsilon \sigma A T^4$$

$\sigma = 5.67 \times 10^{-8} \text{ W/m}^2 \cdot \text{K}^4$, ϵ = emissivity, A = area, T = temperature in K

Wien's displacement law

$$\lambda_{\text{max}} T = 2.898 \times 10^{-3} \text{ m} \cdot \text{K}$$

Tip: Hotter body emits at shorter (bluer) wavelengths

Newton's law of cooling

$$dT/dt = -k(T - T_0)$$

T_0 = ambient temperature, k = cooling constant

Ch 11. Thermodynamics

First law of thermodynamics

$$\Delta U = Q - W$$

ΔU = change in internal energy, Q = heat added to system, W = work done by system

Tip: Sign convention: Q +ve when added to system; W +ve when done BY system

Work done by gas (isobaric)

$$W = P\Delta V = P(V_2 - V_1)$$

Efficiency of Carnot engine

$$\eta = 1 - T_2/T_1$$

T_1 = source temperature (K), T_2 = sink temperature (K)

Tip: Always use temperatures in Kelvin

COP of refrigerator

$$\text{COP} = T_2 / (T_1 - T_2) = Q_2/W$$

Q_2 = heat extracted from cold reservoir

Entropy change (J/K)

$$\Delta S = Q/T \text{ (reversible process)}$$

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Relation for C_p and C_v

$$C_p - C_v = R$$

$$R = 8.314 \text{ J/mol}\cdot\text{K}$$

Adiabatic process

$$PV^\gamma = \text{constant} \quad | \quad TV^{(\gamma-1)} = \text{constant}$$

$$\gamma = C_p/C_v$$

Ch 12. Kinetic Theory

Ideal gas law

$$PV = nRT$$

n = moles, $R = 8.314 \text{ J/mol}\cdot\text{K}$, T = temperature in K

Kinetic energy per molecule

$$KE = \frac{3}{2} kT$$

$$k = 1.38 \times 10^{-23} \text{ J/K (Boltzmann constant)}$$

Tip: Average KE depends only on temperature, not mass

RMS speed

$$v_{\text{rms}} = \sqrt{3RT/M} = \sqrt{3kT/m}$$

M = molar mass, m = mass of one molecule

Average speed

$$v_{\text{avg}} = \sqrt{8RT/\pi M}$$

Most probable speed

$$v_{\text{mp}} = \sqrt{2RT/M}$$

Tip: Speeds order: $v_{\text{mp}} < v_{\text{avg}} < v_{\text{rms}}$

Degrees of freedom: monatomic gas

$$f = 3 \quad | \quad U = \frac{3}{2} nRT$$

Degrees of freedom: diatomic gas

$$f = 5 \quad | \quad U = \frac{5}{2} nRT$$

Mean free path

$$\lambda = 1/(\sqrt{2} \pi d^2 n)$$

d = diameter of molecule, n = number density

Ch 13. Oscillations

Displacement in SHM

$$x = A \sin(\omega t + \phi)$$

A = amplitude, ω = angular frequency, ϕ = initial phase

Angular frequency of spring-mass

$$\omega = \sqrt{k/m} \rightarrow T = 2\pi\sqrt{m/k}$$

k = spring constant, m = mass

Tip: T depends on mass and spring constant, not amplitude

Time period of simple pendulum

$$T = 2\pi\sqrt{l/g}$$

l = effective length

Tip: T independent of mass and amplitude (for small oscillations)

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Velocity in SHM

$$v = \omega\sqrt{A^2 - x^2}$$

Tip: Maximum velocity $v_{\text{max}} = \omega A$ at $x = 0$

Acceleration in SHM

$$a = -\omega^2 x$$

Tip: Acceleration is always directed towards mean position

Total energy in SHM

$$E = \frac{1}{2}kA^2 = \frac{1}{2}m\omega^2 A^2$$

Tip: Total energy is constant; independent of position

Kinetic energy in SHM

$$KE = \frac{1}{2}m\omega^2(A^2 - x^2)$$

Potential energy in SHM

$$PE = \frac{1}{2}m\omega^2 x^2$$

Ch 14. Waves

Wave speed (m/s)

$$v = f\lambda$$

f = frequency (Hz), λ = wavelength (m)

Wave speed on string

$$v = \sqrt{T/\mu}$$

T = tension, μ = linear mass density (kg/m)

Wave speed in gas

$$v = \sqrt{\gamma P/\rho}$$

γ = ratio of specific heats, P = pressure, ρ = density

Speed of sound in air

$$v \approx 331 + 0.6T \text{ m/s}$$

T = temperature in $^{\circ}\text{C}$

Tip: Speed increases with temperature

Standing waves: nodes and antinodes

$$\lambda = 2L/n \text{ for both ends fixed} \quad | \quad \lambda = 4L/(2n-1) \text{ for one end open}$$

Fundamental frequency (string)

$$f_1 = v/2L = (1/2L)\sqrt{T/\mu}$$

Doppler effect (source moving towards observer)

$$f' = f(v + v_o) / (v - v_s)$$

v_o = observer speed, v_s = source speed

Tip: Use $+v_o$ if observer moves towards source, $-v_o$ if away

Beats

$$\text{Beat frequency} = |f_1 - f_2|$$

Tip: Beats are heard when two close frequencies are superimposed